



PCI-SIG ENGINEERING CHANGE NOTICE

TITLE:	Host Socket Recommendations
DATE:	Updated June 12, 2006 (Initial release – April 10, 2006)
AFFECTED DOCUMENT:	PCI Express Mini Card, Half-Mini Card ECR (Content of which is included herein)
SPONSOR:	Brad Saunders, Intel Corporation

Part I

- 5 1. Summary of the Functional Changes
 - Defines recommendations around host socket implementation to allow support for both full-mini-Card and half-mini-Cards.
 - Defines recommendations to card developers regarding support of multi-use sockets and multi-socket host implementations.
- 10 2. Benefits as a Result of the Changes
 - With the introduction of the Half-Mini CEM, more flexibility is afforded the host platform designer to accommodate multiple technologies. This change is intended to help unify the industry on a couple of configuration options that address supporting a potential mix of Full-Mini and Half-Mini cards in a single platform.
- 15 3. Assessment of the Impact
 - No required impact to the current Mini-CEM form factor requirements although compatibility of existing Mini Cards with some future platforms may be limited by not following the recommended practices.
4. Analysis of the Hardware Implications
- 20
 - No changes to current Mini-CEM form factor hardware is required. Future cards developed may be enhanced by following the recommended practices of this change.
5. Analysis of the Software Implications
 - None known at this time.

Part II

Detailed Description of the changes (and includes the Half-Mini Card ECN changes)

2. Mechanical Specification

2.1 Overview

This specification defines two small form factor cards for systems in which a PCI Express add-in card cannot be used due to mechanical system design constraints. The specification defines smaller cards based on a single 52-pin card-edge type connector for system interfaces. The specification also defines the PCI Express Mini Card system board connector. In this document *Mini Card* refers to either form-factor. As the two form-factors primarily differ in length, they will be individually identified as the *Full-Mini Card* and *Half-Mini Card* for the full length and half-length versions of the cards, respectively.

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2.2 Card Specifications

There are two PCI Express Mini Card add-in card sizes, Full-Mini Card and Half-Mini Card.
For purposes of the drawings in this specification, the following notes apply:

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- All dimensions are in millimeters, unless otherwise specified.
- All dimension tolerances are ± 0.15 mm, unless otherwise specified.
- Dimensions marked with an asterisk (*) are overall envelope dimensions and include space allowances for insulation to comply with regulatory and safety requirements.
- Insulating material shall not interfere with or obstruct mounting holes or grounding pads.

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2.2.1 Card Form Factor

The card form factors are specified by Figure 2-1 and Figure 2-2. These figures illustrate example applications. The hatched area shown in this figure represents the available component volume for the card's circuitry.

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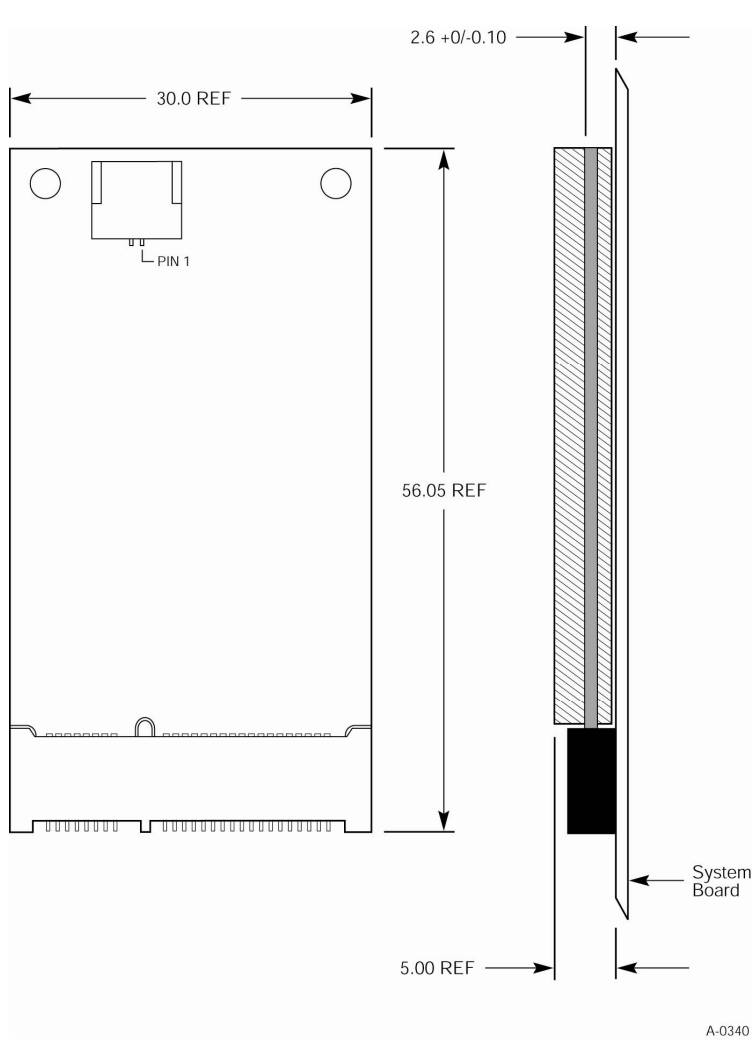
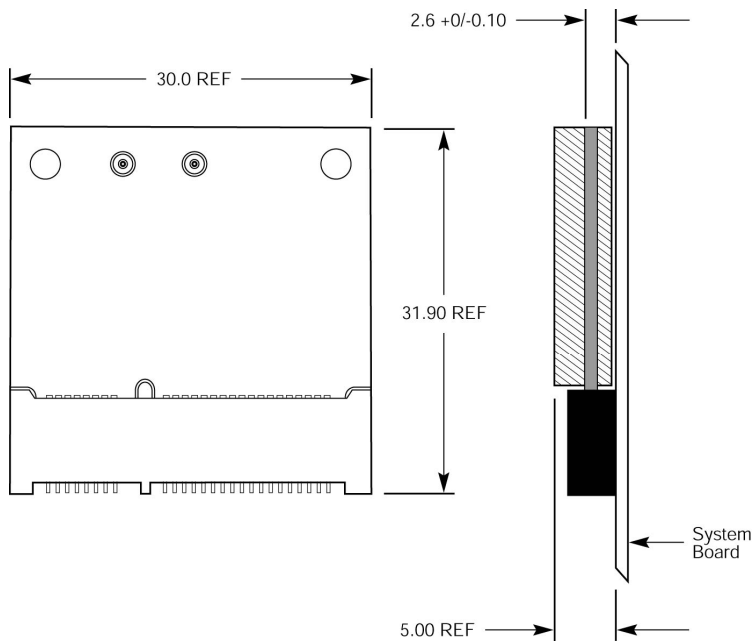


Figure 2-1: Full-Mini Card Form Factor (Modem Example Application Shown)

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Figure 2-2: Half-Mini Card Form Factor (Wireless Example Application Shown)

2.2.2 Card and Socket Types

Given the multiple card sizes defined for Mini Card, host platforms have options with regard to socket configurations implemented to support each of the card sizes and potentially the mixing of the two card sizes within a common socket arrangement.

Single socket arrangements include those specific to Full-Mini Card (F1) and Half-Mini Card (H1) only usages. These sockets specifically have the card retention features for only one size card and are further defined in Section 2.5.1.

Additionally, a single socket that optionally supports either a Full-Mini Card (F2) or a Half-Mini Card (H1 or H2) is possible to implement, this type being referred to as a dual-use socket and supports card retention for both size cards. See Section 2.5.2 for more details on this socket definition.

A dual head-to-head socket is defined as an optional way to incorporate two socket connectors (identified as A and B) into a space that most closely replaces a single Full-Mini socket. This arrangement offers the choice of installing two Half-Mini Cards (one of which has to be a H2 type) or one Full-Mini Card (F2) enabling some additional flexibility for a selection of BTO options. See Section 2.5.3 for more details on this socket definition.

Table 2-x defines cross-compatibility for a series of defined card and socket types. It is important to notice that the dual head-to-head socket arrangement has special limitations with regard to card compatibility.

Table 2-x: Card and Socket Types Cross-Compatibility

Card Types		<u>Full-Mini only socket¹</u>	<u>Half-Mini only socket</u>	<u>Dual-Use socket</u>	<u>Dual Head-to-Head Socket</u>	
		<u>Connector A</u>	<u>Connector A</u>	<u>Connector A</u>	<u>Connector A</u>	<u>Connector B</u>
<u>F1</u>	<u>Full-Mini¹</u>	<u>Yes</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>
<u>F2</u>	<u>Full-Mini with bottom-side keep outs</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>
<u>H1</u>	<u>Half-Mini</u>	<u>No</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>
<u>H2</u>	<u>Half-Mini with bottom-side keep outs</u>	<u>No</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>

¹ Equivalent to original Mini Card defined card and socket in Revision 1.1 of this specification.

Mini Cards that were developed prior to this type definition are by default identified as Type F1. Given that the existing design meets the bottom-side keep out definition for Type F2, then subsequently identifying the product as Type F2 is acceptable.

2.2.3 Card PCB Details

Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6 provide the printed circuit board (PCB) details required to fabricate the card. The PCB for this application is expected to be 1.0 mm thick.

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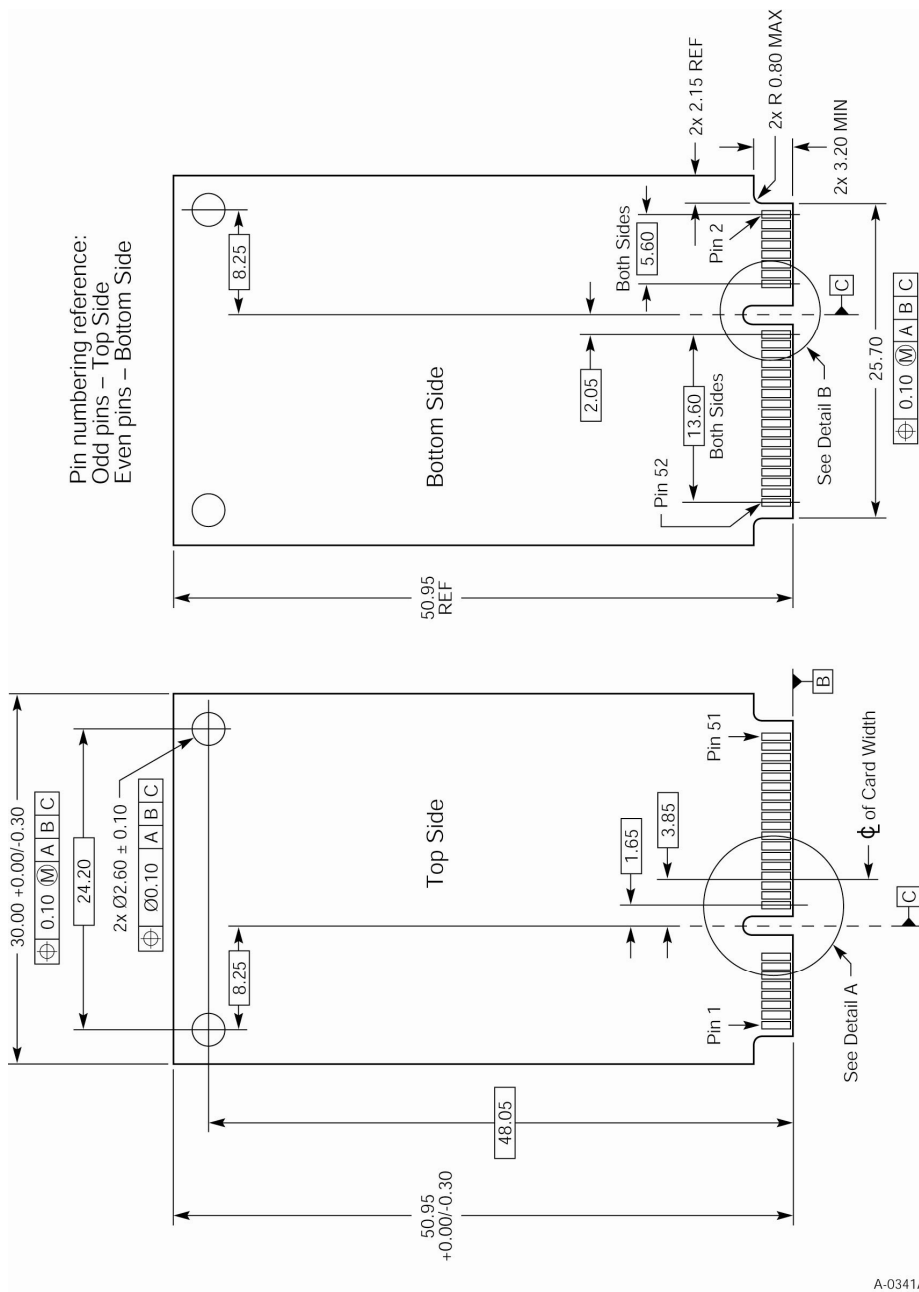


Figure 2-3: Full-Mini Card Top and Bottom

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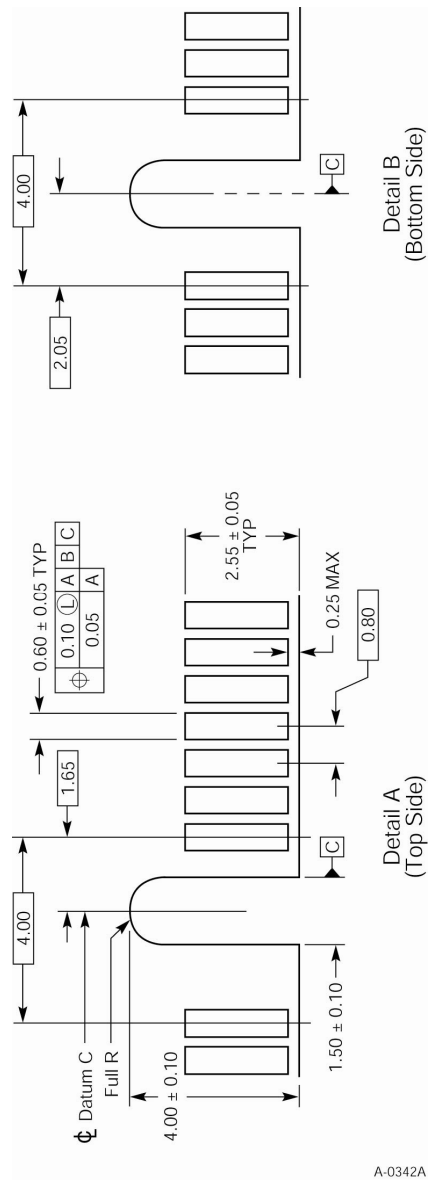


Figure 2-5: Card Top and Bottom Details A and B

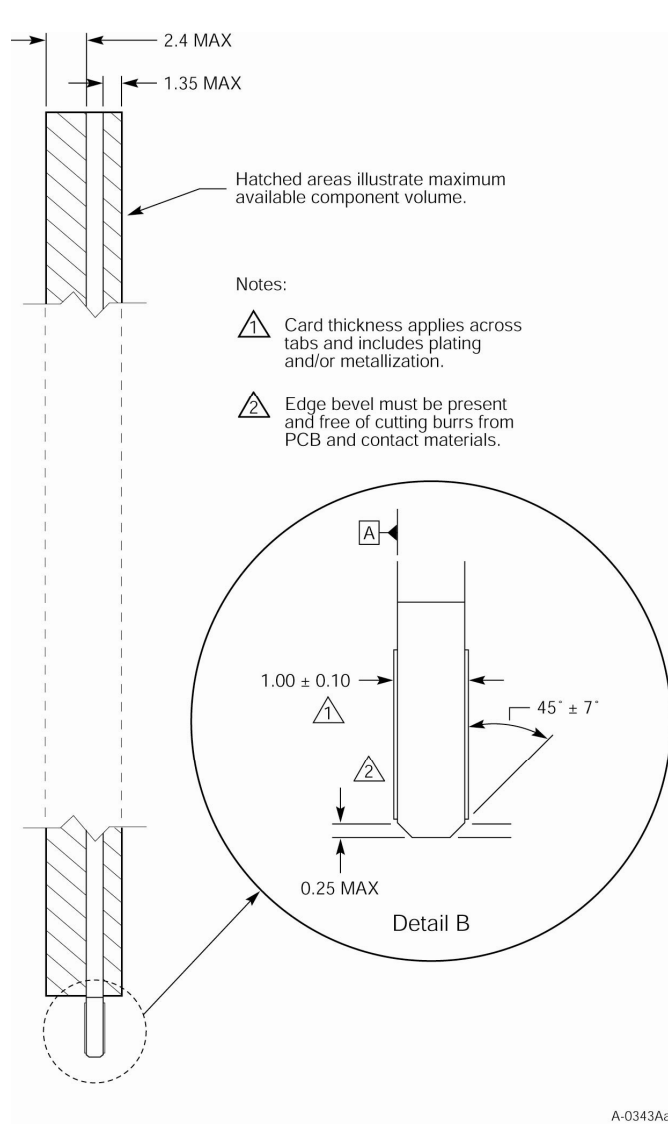
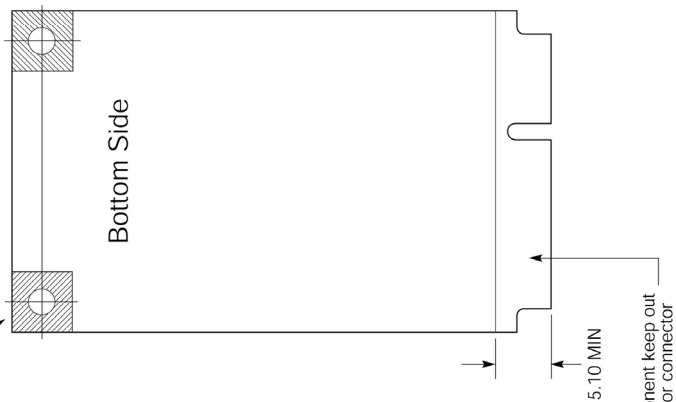
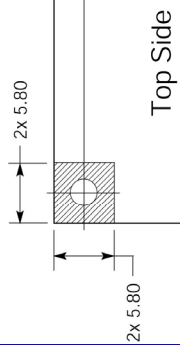


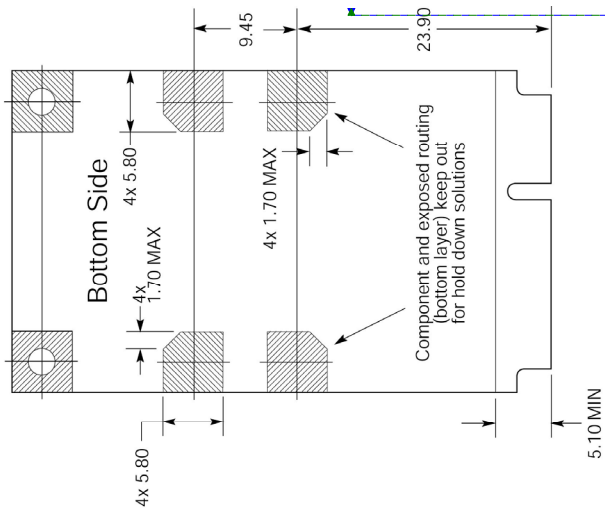
Figure 2-6: Card Edge

[Figure 2-7 and Figure 2-8 provides details regarding the component keep out areas on Full-Mini \(Types F1 and F2\) and Half-Mini Cards \(Types H1 and H2\), respectively.](#)

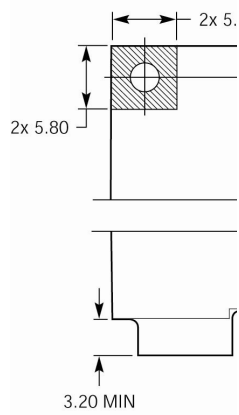
Component and routing (all layers)
keep out area for hold down solutions



Top Side
(Types F1 and F2)



Bottom Side
(Type F2)



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Figure 2-7: Card Component Keep Out Areas [for Full-Mini Cards](#)



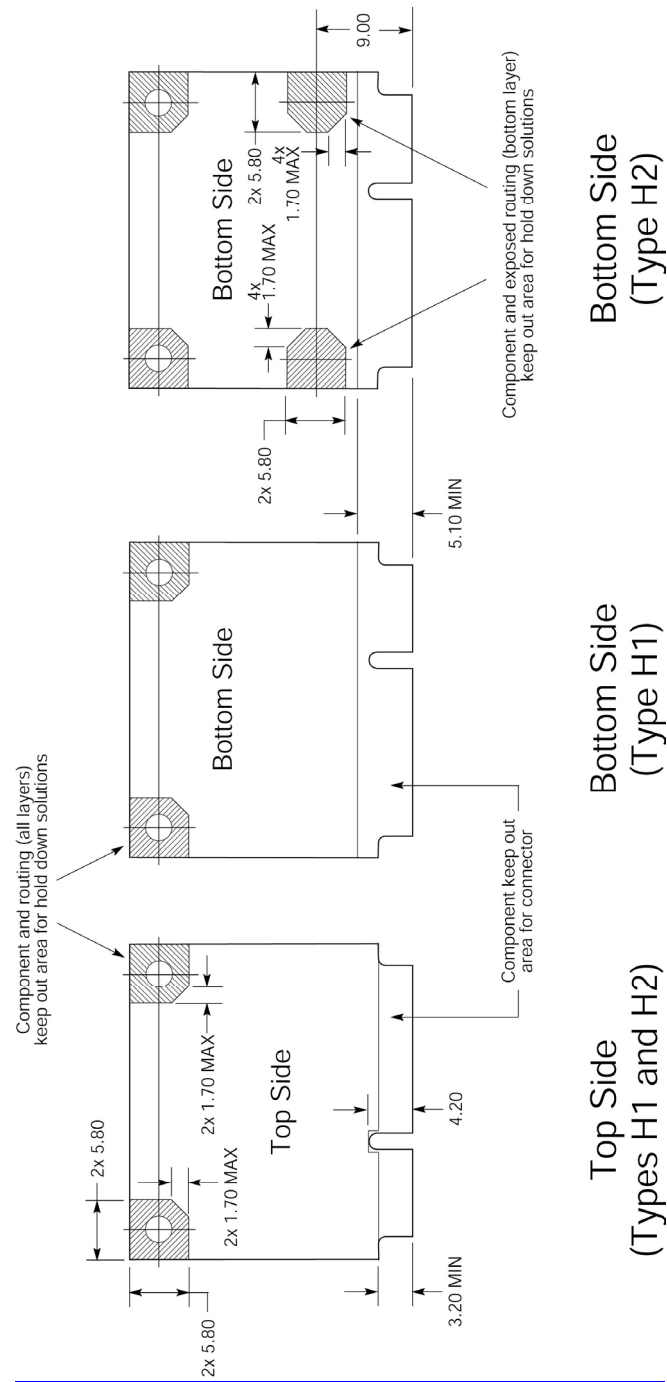


Figure 2-8: Card Component Keep Out Areas for Half-Mini Cards

2.3 System Connector Specifications

The PCI Express Mini Card system connector is similar to the SO-DIMM connector and is modeled after the Mini PCI Type III connector without side retaining clips.

Note: All dimensions are in millimeters, unless otherwise specified. All dimension tolerances are ± 0.15 mm, unless otherwise specified.

2.3.1 System Connector

The system connector is 52-pin card edge type connector. Detailed dimensions should be obtained from the connector manufacturer. Figure 2-9 shows the system connector.

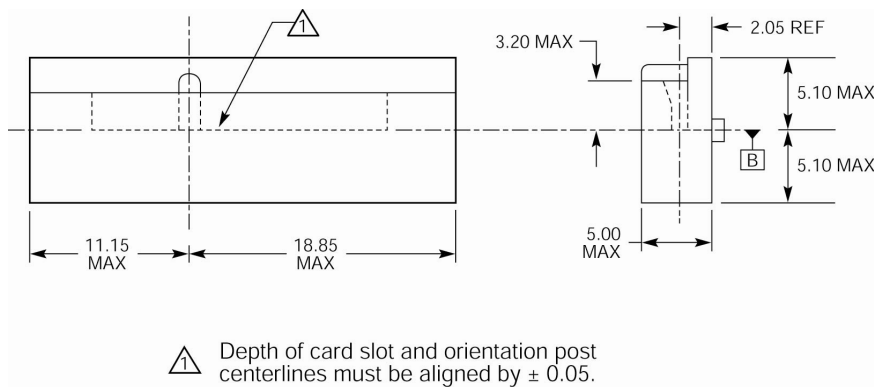


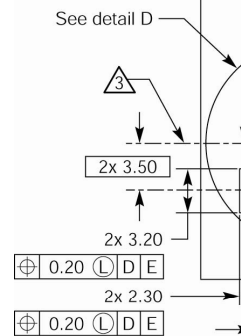
Figure 2-9: PCI Express Mini Card System Connector

2.3.2 System Connector Parametric Specifications

Table 2-1, Table 2-2, Table 2-3, and Table 2-4 specify the requirements for physical, mechanical, electrical, and environmental performance for the system connector.

Table 2-1: System Connector Physical Requirements

Parameter	Specification
Connector Housing	U.L. rated 94-V-1 (minimum) Must be compatible with lead-free soldering process
Contacts: Receptacle	Copper alloy
Contact Finish: Receptacle	Must be compatible with lead-free soldering process



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Deleted: Figure 2-9, Figure 2-10, Figure 2-11, and Figure 2-12 show the recommended locations of the PCI Express Mini Card system connector on the system board.

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Table 2-2: System Connector Mechanical Performance Requirements

Parameter	Specification
Durability	EIA-364-9 50 cycles
Total mating/unmating force*	EIA-364-13 2.3 kgf maximum
Shock	EIA-364-27, Test condition A Add to EIA-364-1000 test group 3 with LLCR before vibration sequence. Note: Shock specifications assume that an effective card retention feature is used.

* Card mating/unmating sequence:

1. Insert the card at the angle specified by the manufacturer.
2. Rotate the card into position.
3. Reverse the installation sequence to unmate.

Table 2-3: System Connector Electrical Performance Requirements

Parameter	Specification
Low Level Contact Resistance	EIA-364-23 55 milliohms maximum (initial) per contact; 20 milliohms maximum change allowed
Insulation Resistance	EIA-364-21 > 5 x 10 ⁸ @ 500 V DC
Dielectric Withstanding Voltage	EIA-364-20 > 300 V AC (RMS) @ sea level
Current Rating	0.50 amp/power contact (continuous) The temperature rise above ambient shall not exceed 30 °C. The ambient condition is still air at 25 °C. EIA-364-70 method 2
Voltage Rating	50 V AC per contact

Table 2-4: System Connector Environmental Performance Requirements

Parameter	Specification
Operating Temperature	-40 °C to +80 °C
Environmental Test Methodology	EIA-364-1000.01 Test Group, 1, 2, 3, and 4
Useful field life	5 years

To ensure that the environmental tests measure the stability of the connector, the add-in cards used shall have edge finger tabs with a minimum plating thickness of 30 micro-inches of gold over 50 micro-inches of nickel (for environmental test purposes only). Furthermore, it is highly desirable that testing gives an indication of the stability of the connector when add-in cards at the lower and

upper limit of the card thickness requirement are used. In any case, both the edge tab plating thickness and the card thickness shall be recorded in the environmental test report.

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2.4 I/O Connector Area

The placement of I/O connectors on a PCI Express Mini Card add-in card is recommended to be at the end opposite of the system connector as shown in Figure 2-10. The recommended area applies to both sides of the card, though typical placement will be on the top of the card due to the additional height available. Depending on the application, one or more connectors may be required to provide for cabled access between the card and media interfaces such as LAN and modem line interfaces and/or RF antennas. This area is not restricted to I/O connectors only and can be used for circuitry if not needed for connectors.

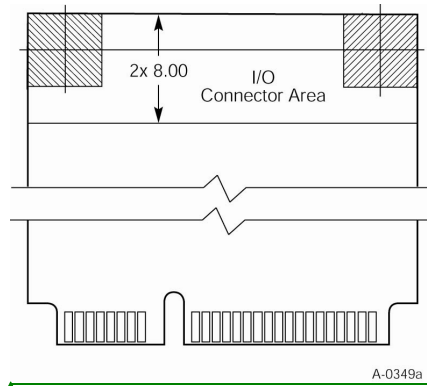


Figure 2-10: I/O Connector Location Areas

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2.5 Recommended Socket Configurations

The following subsections address various recommended footprints for the system connector covering single-use sockets, dual-use sockets and multi-socket configurations.

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2.5.1 Single Use Full-Mini and Half-Mini Sockets

Figure 2-11, Figure 2-12, and Figure 2-13 show the recommended system board layouts for single use sockets.

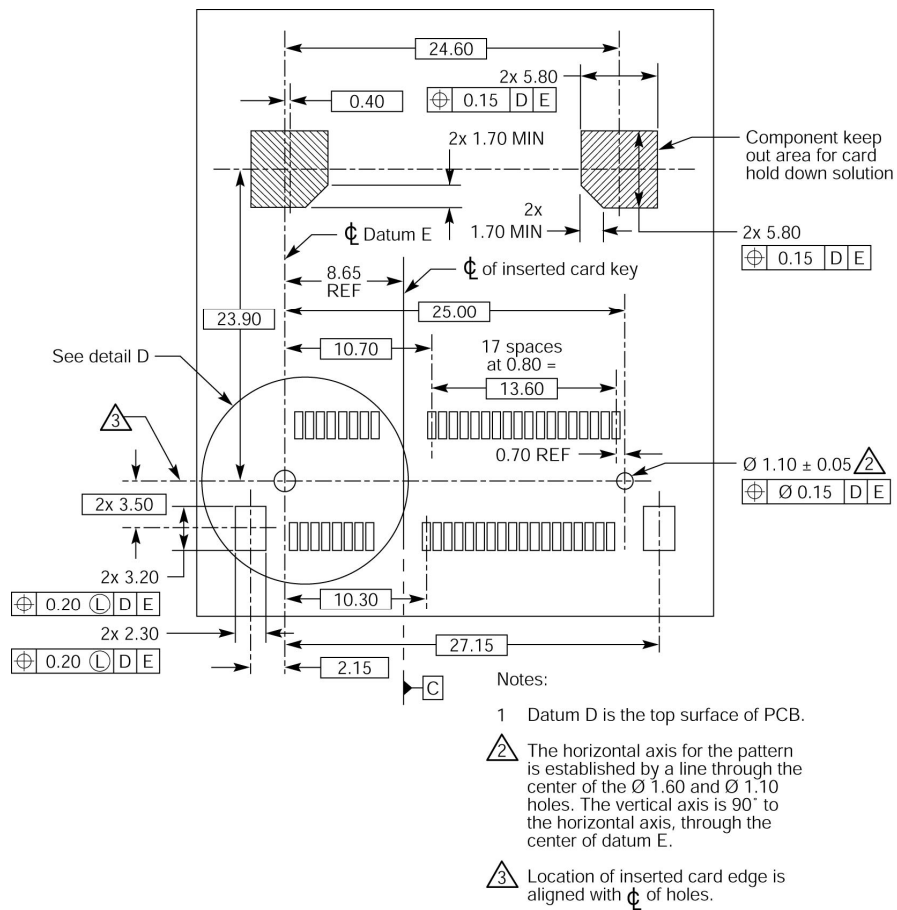


Figure 2-12: Recommended System Board Layout for Half-Mini-only Socket

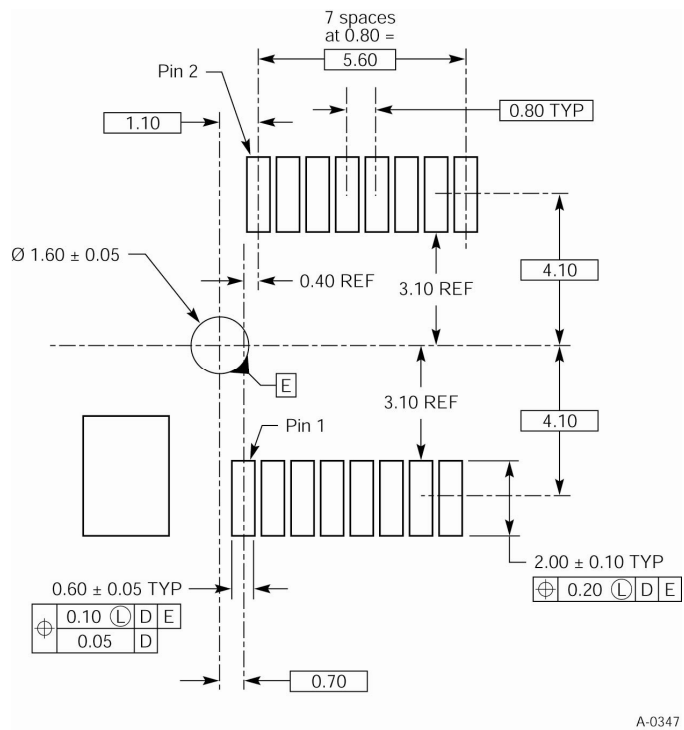


Figure 2-13: Recommended System Board Layout (Detail D)

2.5.2 Dual Use Sockets

Figure 2-14 illustrates the concept of a dual-use socket that can accept either a Full-Mini Card or a Half-Mini Card. This socket differs from the Full-Mini-only socket in that consideration is given to support hold down support for the installation of a Half-Mini Card into the same socket. All Mini Cards with the exception of the Type F1 Full-Mini Card are compatible with this socket.

Figure 2-15 shows the recommended system board layout for the dual-use socket.

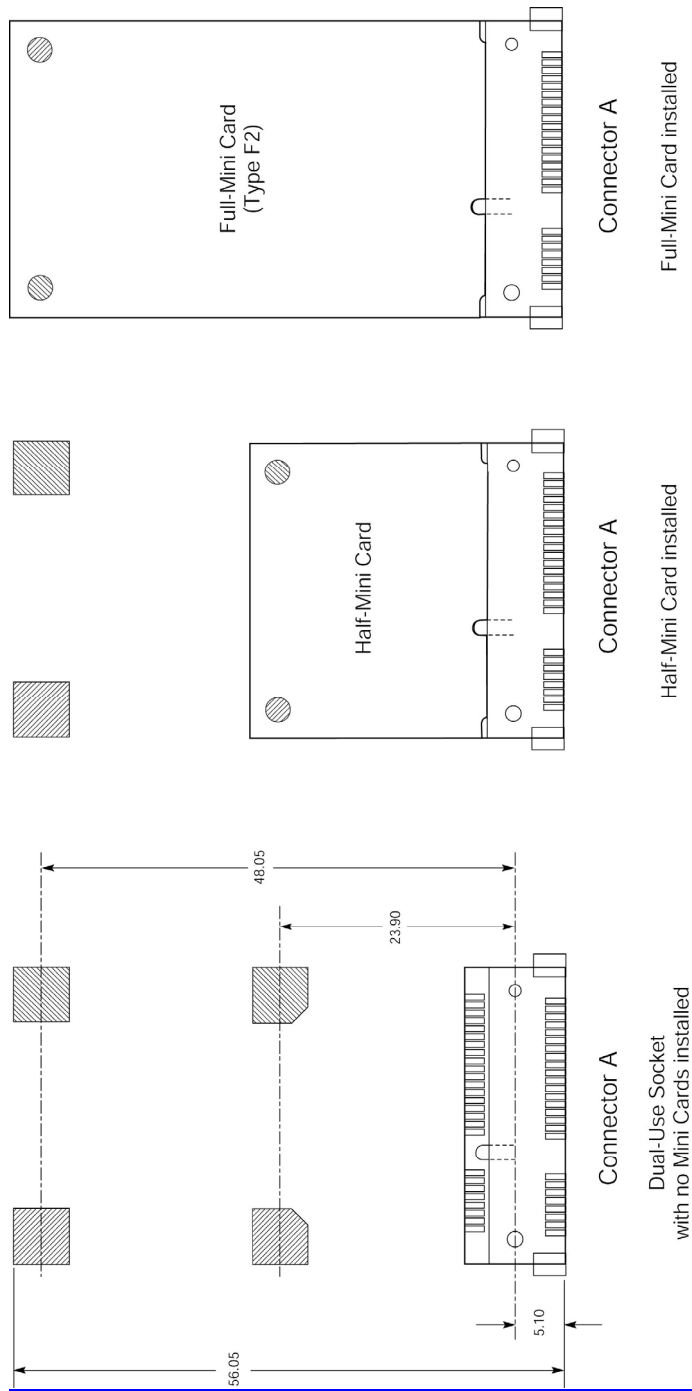


Figure 2-14: Dual-Use Socket

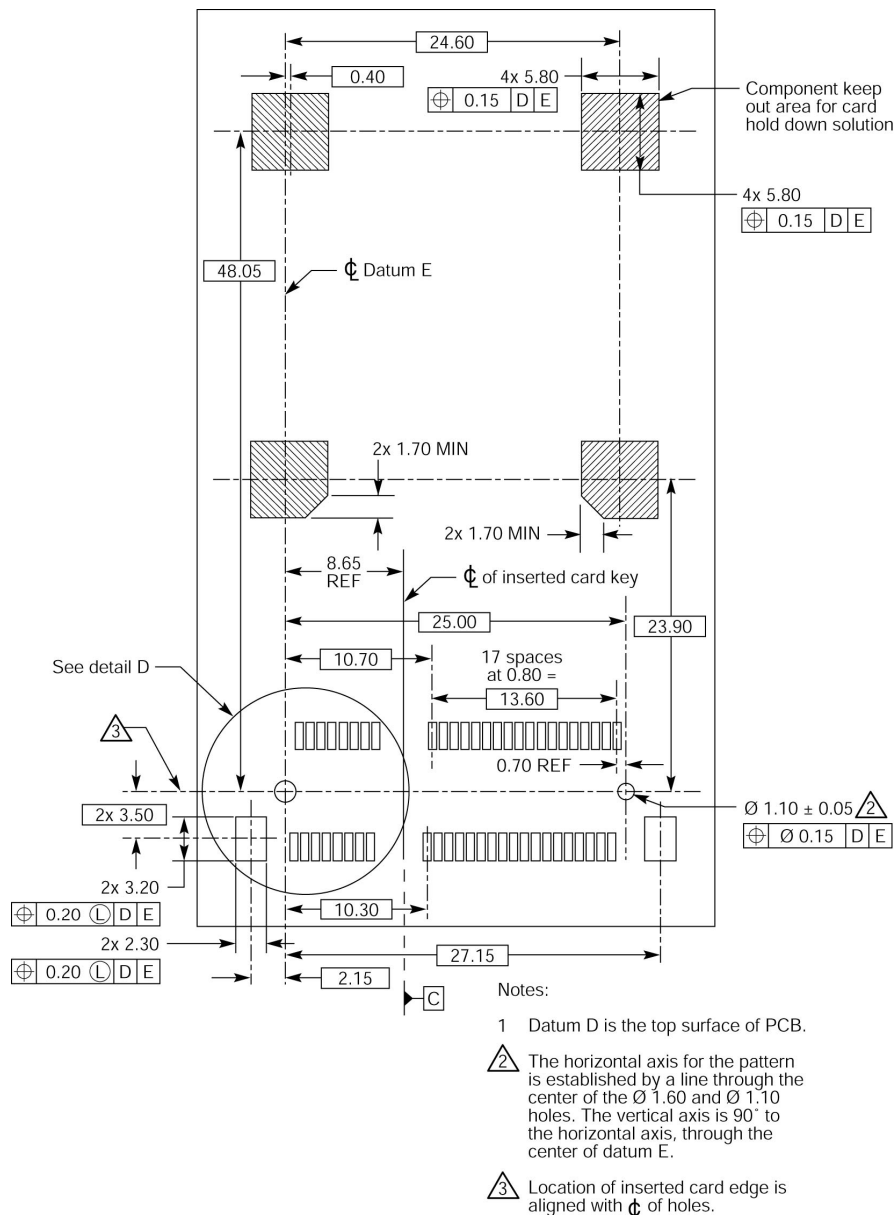


Figure 2-15: Recommended System Board Layout for Dual-Use Socket

2.5.3 Dual Head-to-Head Sockets

Figure 2-16 illustrates the concept of a dual head-to-head socket configuration. This optional configuration defines a two connector (A and B) solution that is intended to allow installation for

either one Full-Mini Card or two Half-Mini Cards. Figure 2-17 shows the recommended system board layout for this configuration based on overlaying the defined dual-use and Half-Mini-only sockets (see Figures 2-12 and 2-15 for additional dimensional details).

- 5 It is important to note the limitations regarding card compatibility with this socket configuration. Connector A can accept all but the Type F1 Full-Mini Card. Connector B can only accept Type H2 Half-Mini Cards. When using two Half-Mini Cards in this configuration, care must be taken that at least one of those cards be Type H2.

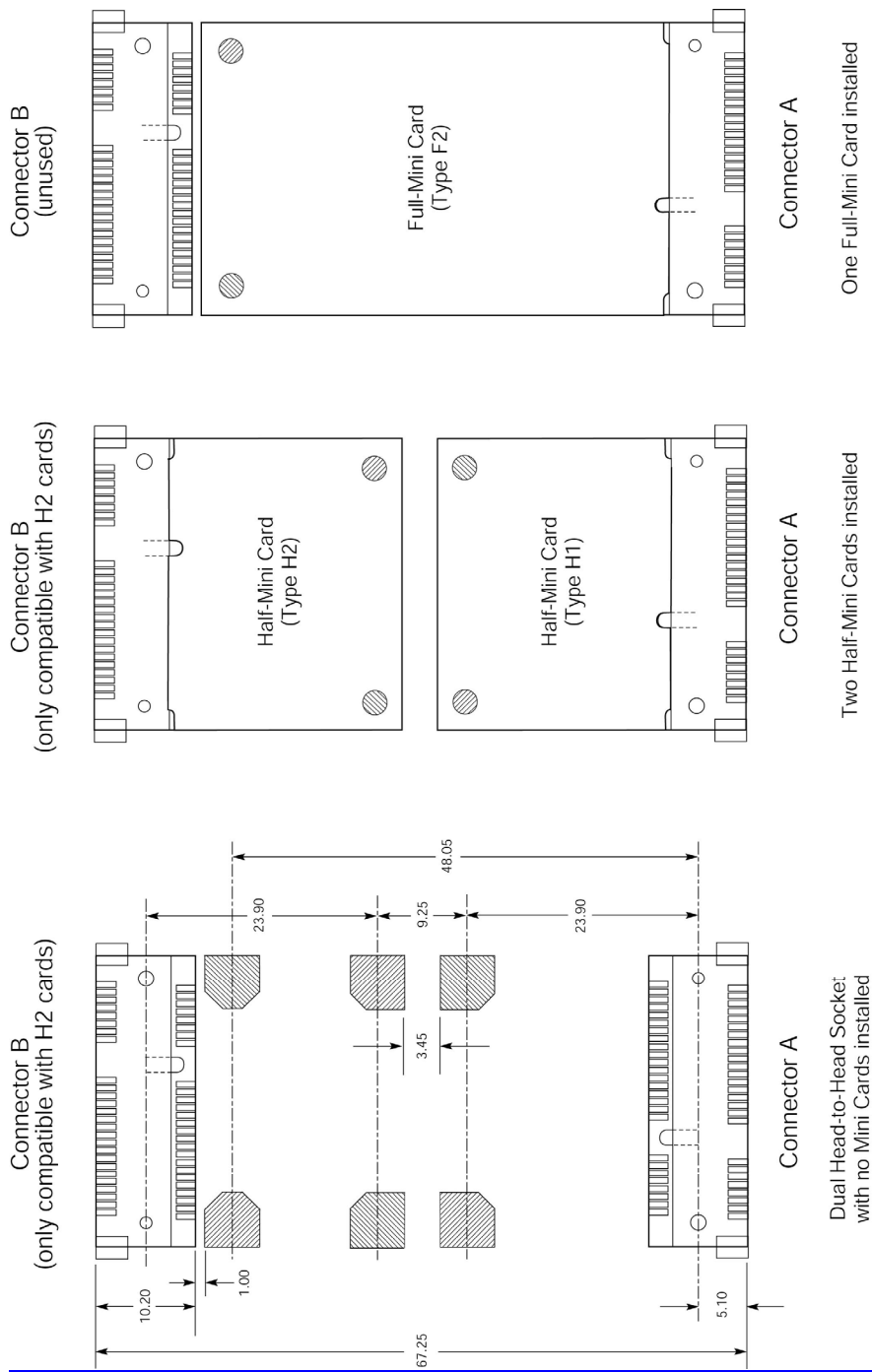


Figure 2-16: Dual Head-to-Head Socket

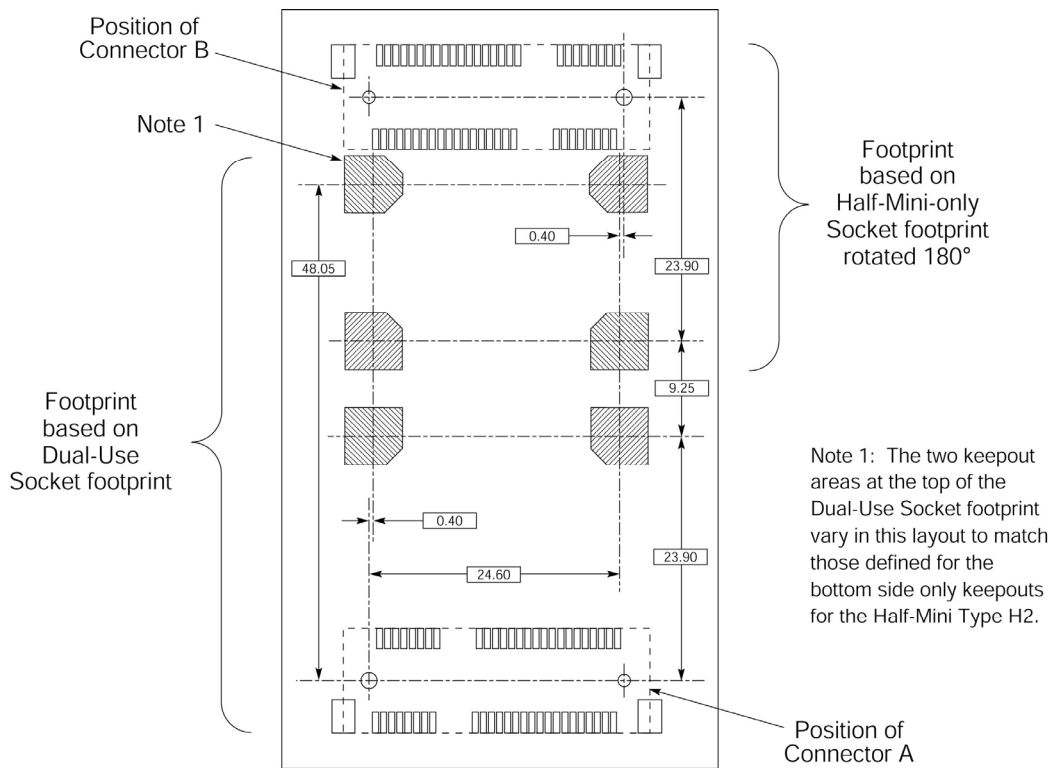


Figure 2-17: Recommended System Board Layout for Dual Head-to-Head Sockets

2.5.4 Side-by-Side Socket Spacing

Figure 2-18 shows the recommendation for placing Mini Card sockets side-by-side on a system board. This recommendation can be combined with any of the other system board recommendations for increased flexibility in managing multiple cards in a single platform.

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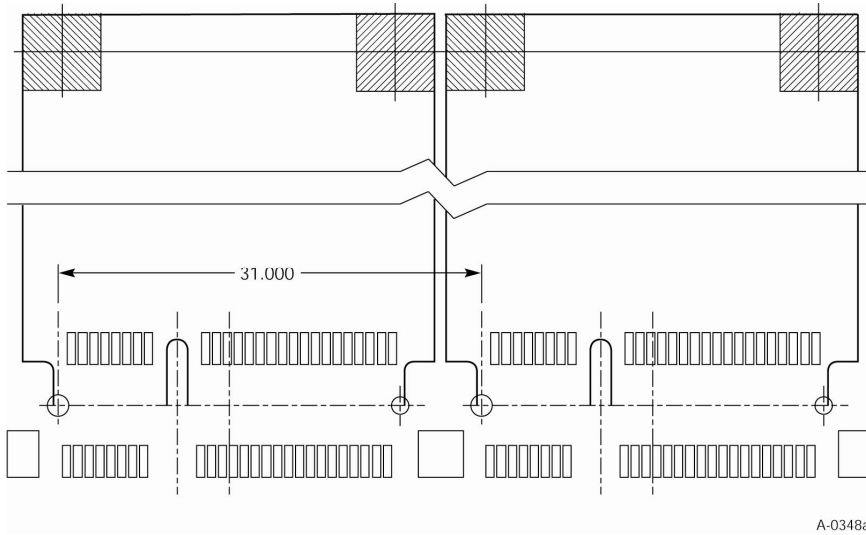


Figure 2-18: Recommended System Board Layout (Side-by-Side Socket Spacing)

2.6 Thermal Guidelines

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Part III

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2. Mechanical Specification

2.1 Overview

This specification defines two small form factor cards for systems in which a PCI Express add-in card cannot be used due to mechanical system design constraints. The specification defines smaller cards based on a single 52-pin card-edge type connector for system interfaces. The specification also defines the PCI Express Mini Card system board connector. In this document *Mini Card* refers to either form-factor. As the two form-factors primarily differ in length, they will be individually identified as the *Full-Mini Card* and *Half-Mini Card* for the full length and half-length versions of the cards, respectively.

2.2 Card Specifications

There are two PCI Express Mini Card add-in card sizes, Full-Mini Card and Half-Mini Card.

For purposes of the drawings in this specification, the following notes apply:

- ☐ All dimensions are in millimeters, unless otherwise specified.
- ☐ All dimension tolerances are ± 0.15 mm, unless otherwise specified.
- ☐ Dimensions marked with an asterisk (*) are overall envelope dimensions and include space allowances for insulation to comply with regulatory and safety requirements.
- ☐ Insulating material shall not interfere with or obstruct mounting holes or grounding pads.

2.2.1 Card Form Factor

The card form factors are specified by Figure 2-1 and Figure 2-2. These figures illustrate example applications. The hatched area shown in this figure represents the available component volume for the card's circuitry.

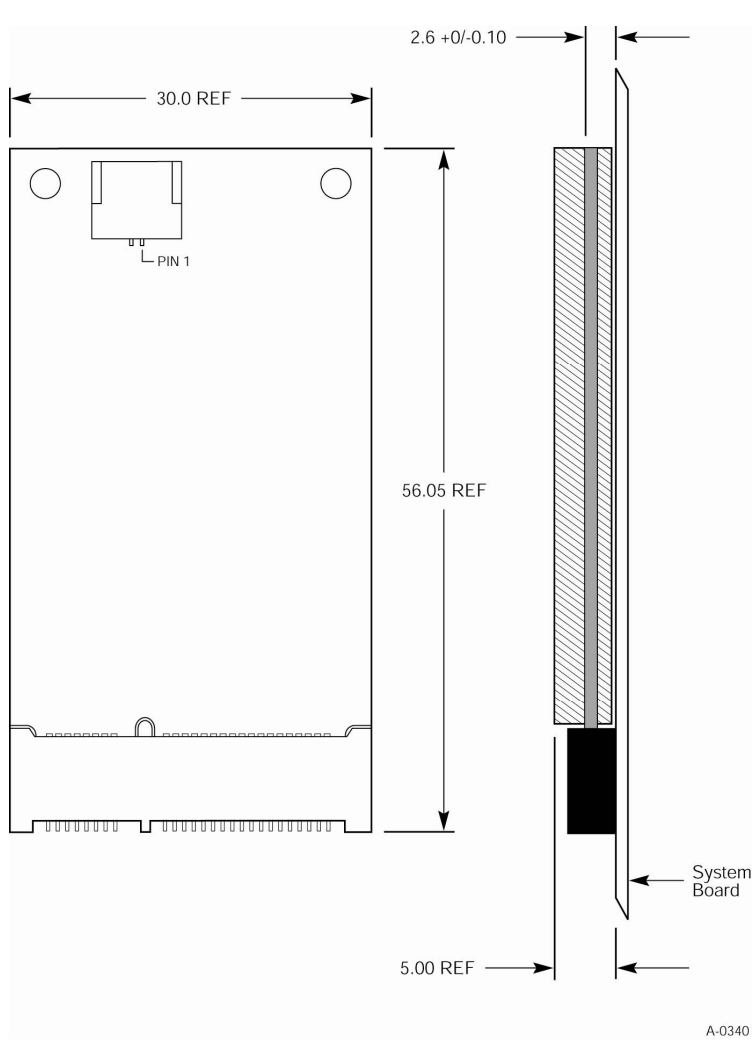


Figure 2-1: Full-Mini Card Form Factor (Modem Example Application Shown)

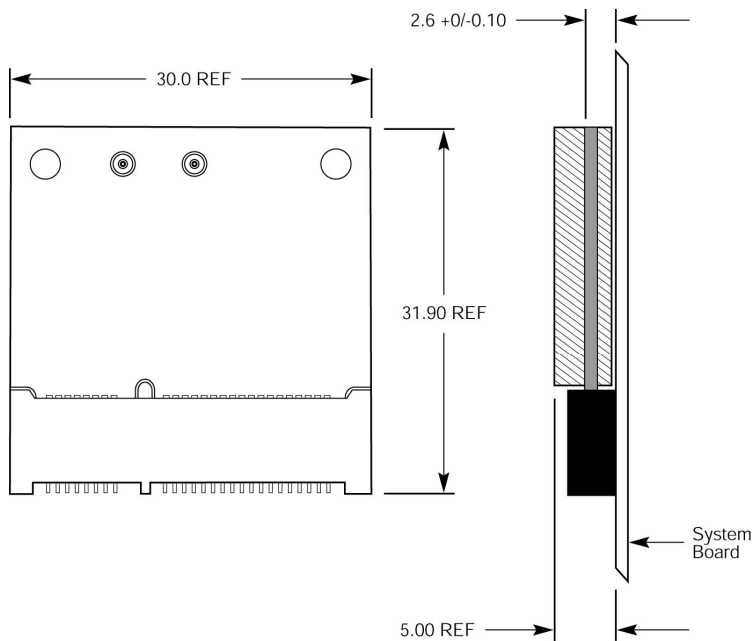


Figure 2-2: Half-Mini Card Form Factor (Wireless Example Application Shown)

2.2.2 Card and Socket Types

Given the multiple card sizes defined for Mini Card, host platforms have options with regard to socket configurations implemented to support each of the card sizes and potentially the mixing of the two card sizes within a common socket arrangement.

Single socket arrangements include those specific to Full-Mini Card (F1) and Half-Mini Card (H1) only usages. These sockets specifically have the card retention features for only one size card and are further defined in Section 2.5.1.

Additionally, a single socket that optionally supports either a Full-Mini Card (F2) or a Half-Mini Card (H1 or H2) is possible to implement, this type being referred to as a dual-use socket and supports card retention for both size cards. See Section 2.5.2 for more details on this socket definition.

A dual head-to-head socket is defined as an optional way to incorporate two socket connectors (identified as A and B) into a space that most closely replaces a single Full-Mini socket. This arrangement offers the choice of installing two Half-Mini Cards (one of which has to be a H2 type) or one Full-Mini Card (F2) enabling some additional flexibility for a selection of BTO options. See Section 2.5.3 for more details on this socket definition.

Table 2-x defines cross-compatibility for a series of defined card and socket types. It is important to notice that the dual head-to-head socket arrangement has special limitations with regard to card compatibility.

Table 2-x: Card and Socket Types Cross-Compatibility

Card Types		Full-Mini only socket ¹	Half-Mini only socket	Dual-Use socket	Dual Head-to-Head Socket	
		Connector A	Connector A	Connector A	Connector A	Connector B
F1	Full-Mini ¹	Yes	No	No	No	No
F2	Full-Mini with bottom-side keep outs	Yes	No	Yes	Yes	No
H1	Half-Mini	No	Yes	Yes	Yes	No
H2	Half-Mini with bottom-side keep outs	No	Yes	Yes	Yes	Yes

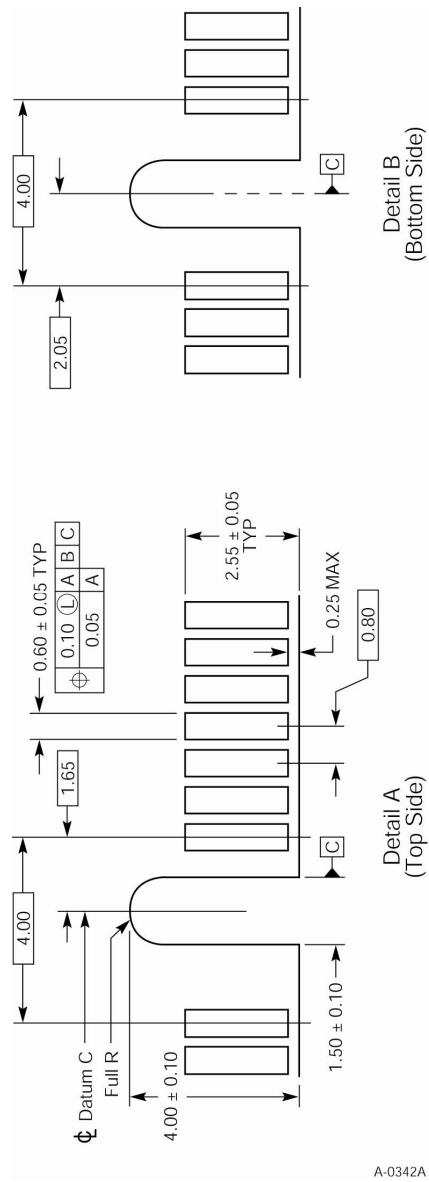
¹ Equivalent to original Mini Card defined card and socket in Revision 1.1 of this specification.

Mini Cards that were developed prior to this type definition are by default identified as Type F1.

- 5 Given that the existing design meets the bottom-side keep out definition for Type F2, then subsequently identifying the product as Type F2 is acceptable.

2.2.3 Card PCB Details

Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6 provide the printed circuit board (PCB) details required to fabricate the card. The PCB for this application is expected to be 1.0 mm thick.



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Figure 2-5: Card Top and Bottom Details A and B

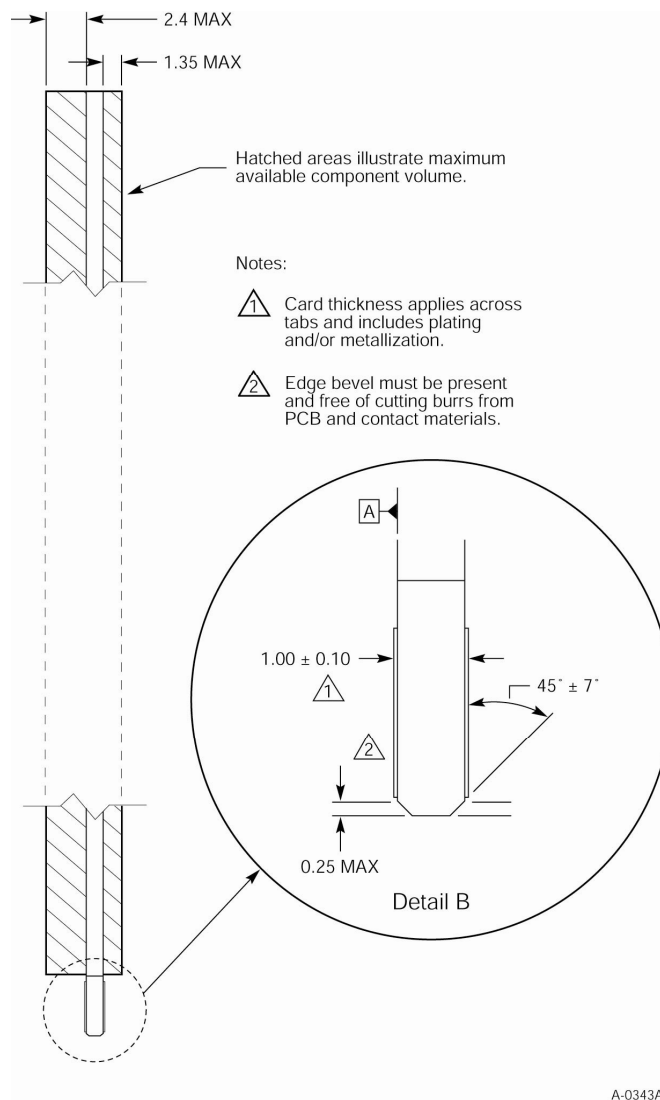


Figure 2-6: Card Edge

Figure 2-7 and Figure 2-8 provides details regarding the component keep out areas on Full-Mini (Types F1 and F2) and Half-Mini Cards (Types H1 and H2), respectively.

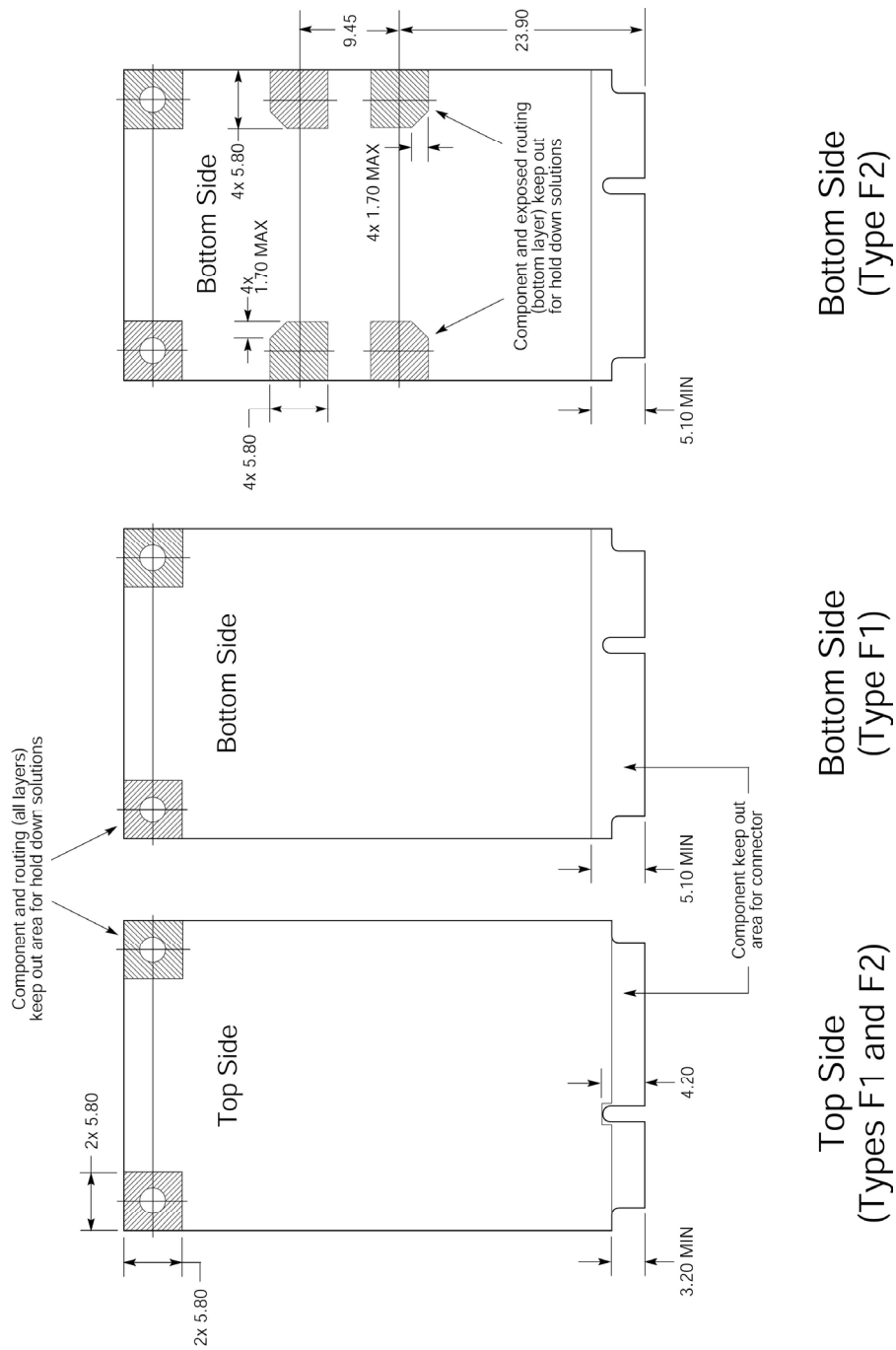


Figure 2-7: Card Component Keep Out Areas for Full-Mini Cards

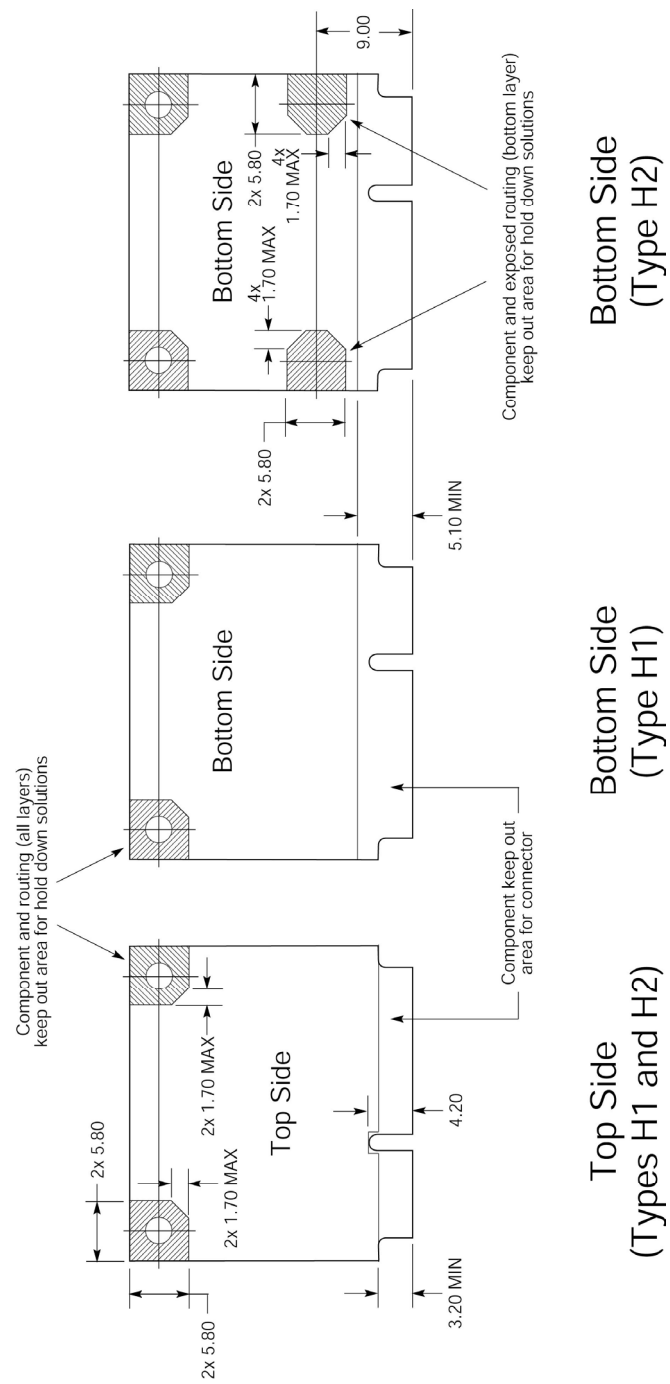


Figure 2-8: Card Component Keep Out Areas for Half-Mini Cards

2.3 System Connector Specifications

The PCI Express Mini Card system connector is similar to the SO-DIMM connector and is modeled after the Mini PCI Type III connector without side retaining clips.

Note: All dimensions are in millimeters, unless otherwise specified. All dimension tolerances are ± 0.15 mm, unless otherwise specified.

2.3.1 System Connector

The system connector is 52-pin card edge type connector. Detailed dimensions should be obtained from the connector manufacturer. Figure 2-9 shows the system connector.

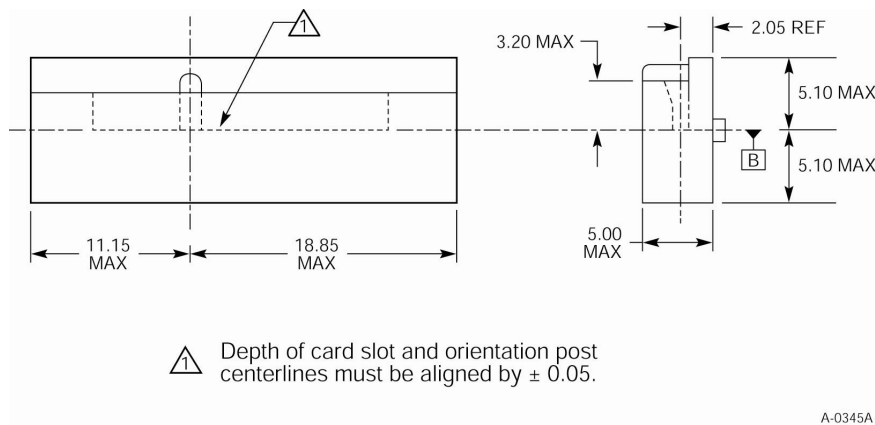


Figure 2-9: PCI Express Mini Card System Connector

2.3.2 System Connector Parametric Specifications

Table 2-1, Table 2-2, Table 2-3, and Table 2-4 specify the requirements for physical, mechanical, electrical, and environmental performance for the system connector.

Table 2-1: System Connector Physical Requirements

Parameter	Specification
Connector Housing	U.L. rated 94-V-1 (minimum) Must be compatible with lead-free soldering process
Contacts: Receptacle	Copper alloy
Contact Finish: Receptacle	Must be compatible with lead-free soldering process

Table 2-2: System Connector Mechanical Performance Requirements

Parameter	Specification
Durability	EIA-364-9 50 cycles
Total mating/unmating force*	EIA-364-13 2.3 kgf maximum
Shock	EIA-364-27, Test condition A Add to EIA-364-1000 test group 3 with LLCR before vibration sequence. Note: Shock specifications assume that an effective card retention feature is used.

* Card mating/unmating sequence:

1. Insert the card at the angle specified by the manufacturer.
2. Rotate the card into position.
3. Reverse the installation sequence to unmate.

Table 2-3: System Connector Electrical Performance Requirements

Parameter	Specification
Low Level Contact Resistance	EIA-364-23 55 milliohms maximum (initial) per contact; 20 milliohms maximum change allowed
Insulation Resistance	EIA-364-21 > 5 x 10 ⁸ @ 500 V DC
Dielectric Withstanding Voltage	EIA-364-20 > 300 V AC (RMS) @ sea level
Current Rating	0.50 amp/power contact (continuous) The temperature rise above ambient shall not exceed 30 °C. The ambient condition is still air at 25 °C. EIA-364-70 method 2
Voltage Rating	50 V AC per contact

Table 2-4: System Connector Environmental Performance Requirements

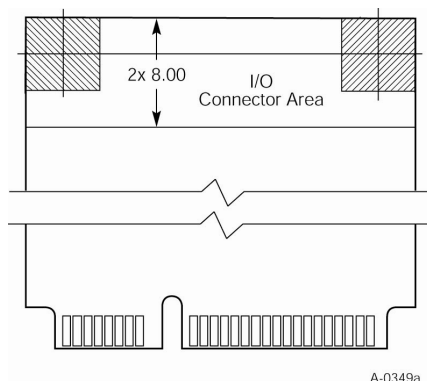
Parameter	Specification
Operating Temperature	-40 °C to +80 °C
Environmental Test Methodology	EIA-364-1000.01 Test Group, 1, 2, 3, and 4
Useful field life	5 years

To ensure that the environmental tests measure the stability of the connector, the add-in cards used shall have edge finger tabs with a minimum plating thickness of 30 micro-inches of gold over 50 micro-inches of nickel (for environmental test purposes only). Furthermore, it is highly desirable that testing gives an indication of the stability of the connector when add-in cards at the lower and

upper limit of the card thickness requirement are used. In any case, both the edge tab plating thickness and the card thickness shall be recorded in the environmental test report.

2.4 I/O Connector Area

The placement of I/O connectors on a PCI Express Mini Card add-in card is recommended to be at the end opposite of the system connector as shown in Figure 2-10. The recommended area applies to both sides of the card, though typical placement will be on the top of the card due to the additional height available. Depending on the application, one or more connectors may be required to provide for cabled access between the card and media interfaces such as LAN and modem line interfaces and/or RF antennas. This area is not restricted to I/O connectors only and can be used for circuitry if not needed for connectors.



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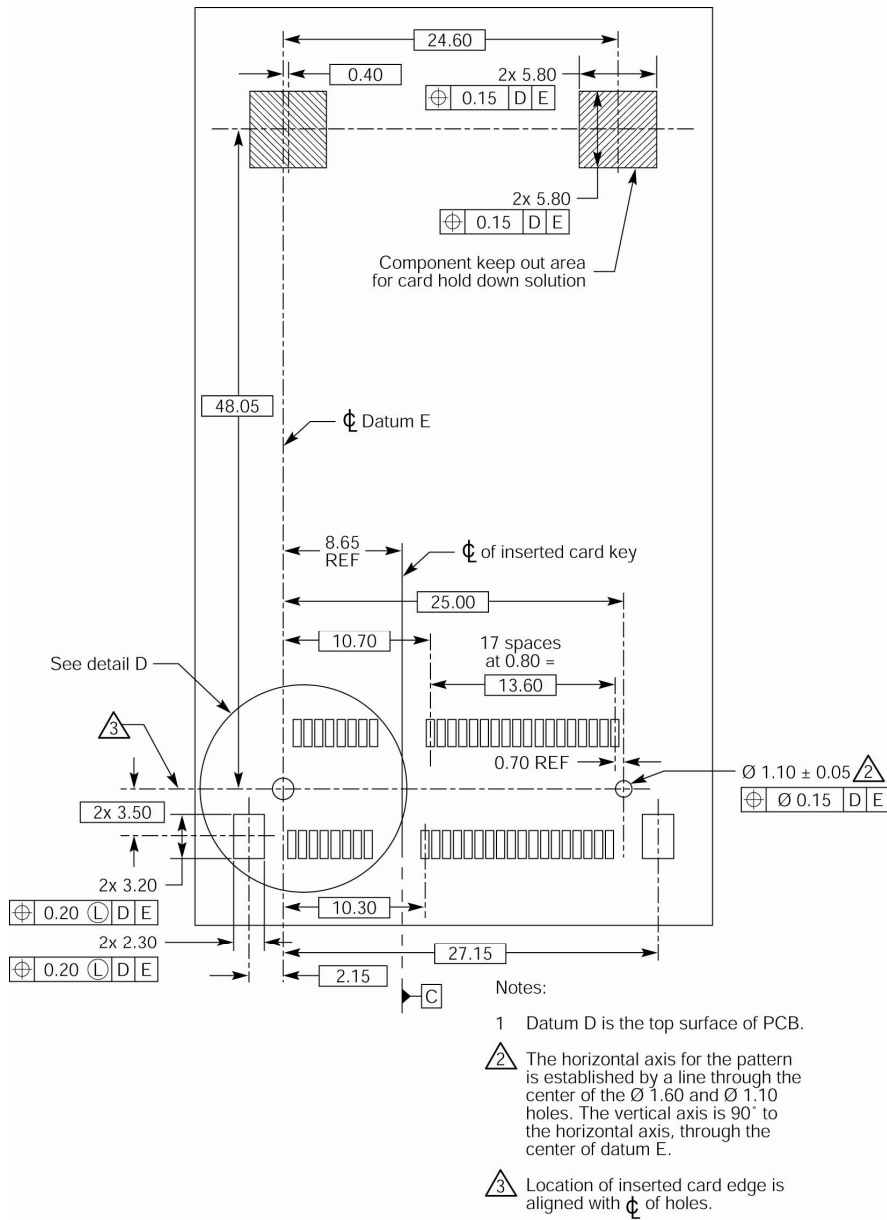
Figure 2-10: I/O Connector Location Areas

2.5 Recommended Socket Configurations

The following subsections address various recommended footprints for the system connector covering single-use sockets, dual-use sockets and multi-socket configurations.

2.5.1 Single Use Full-Mini and Half-Mini Sockets

Figure 2-11, Figure 2-12, and Figure 2-13 show the recommended system board layouts for single use sockets.



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Figure 2-11: Recommended System Board Layout for Full-Mini-only Socket



Figure 2-12: Recommended System Board Layout for Half-Mini-only Socket

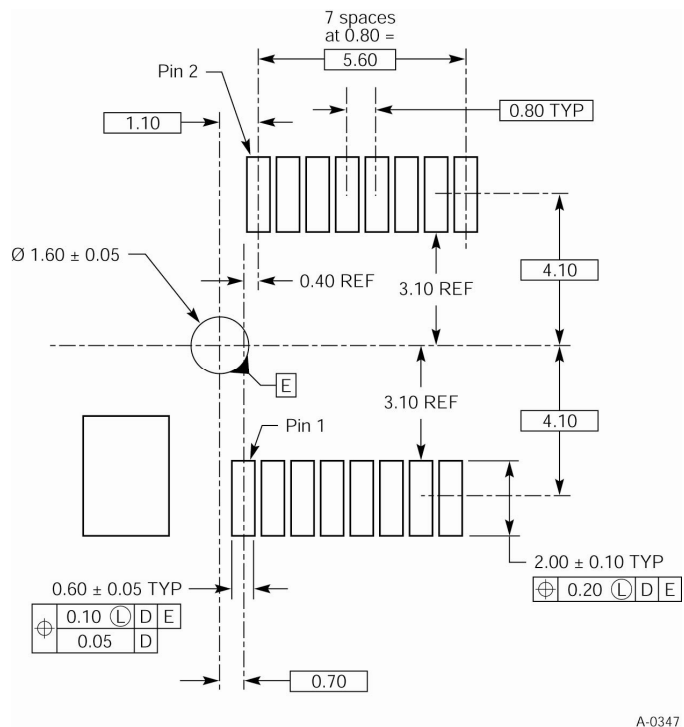


Figure 2-13: Recommended System Board Layout (Detail D)

2.5.2 Dual Use Sockets

Figure 2-14 illustrates the concept of a dual-use socket that can accept either a Full-Mini Card or a Half-Mini Card. This socket differs from the Full-Mini-only socket in that consideration is given to support hold down support for the installation of a Half-Mini Card into the same socket. All Mini Cards with the exception of the Type F1 Full-Mini Card are compatible with this socket.

Figure 2-15 shows the recommended system board layout for the dual-use socket.

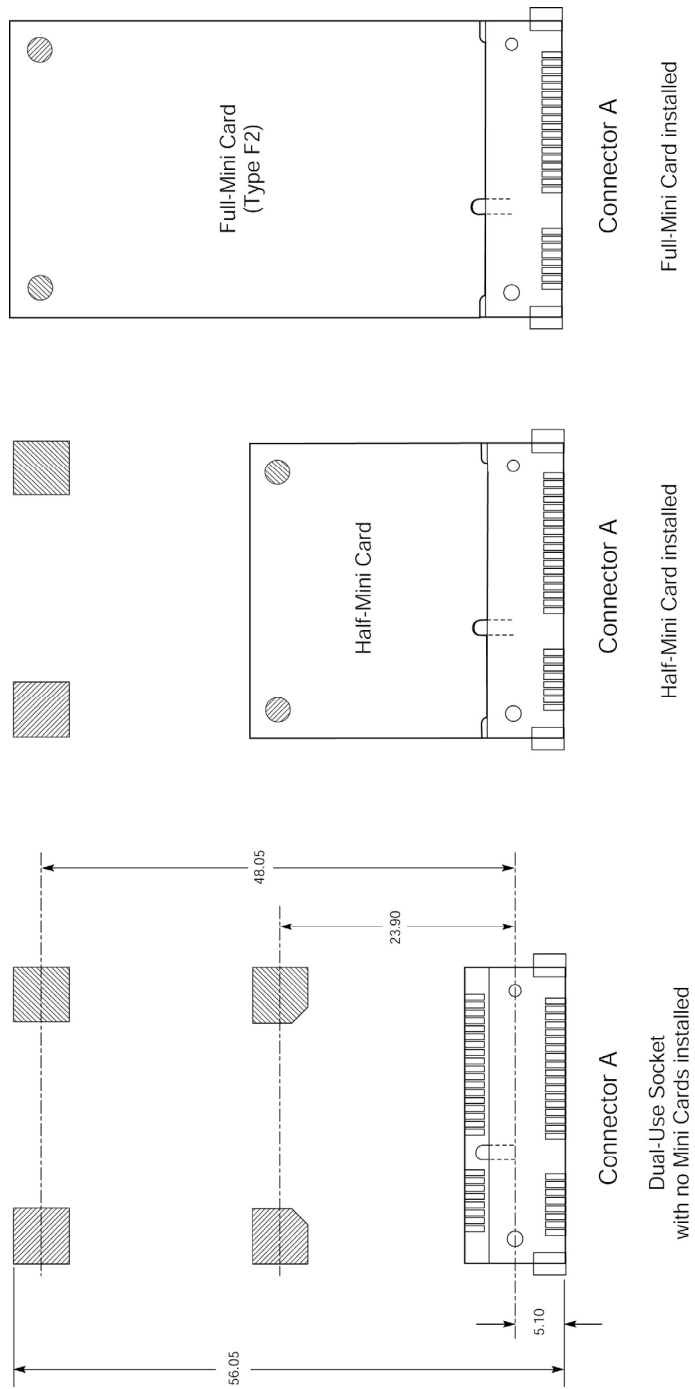


Figure 2-14: Dual-Use Socket

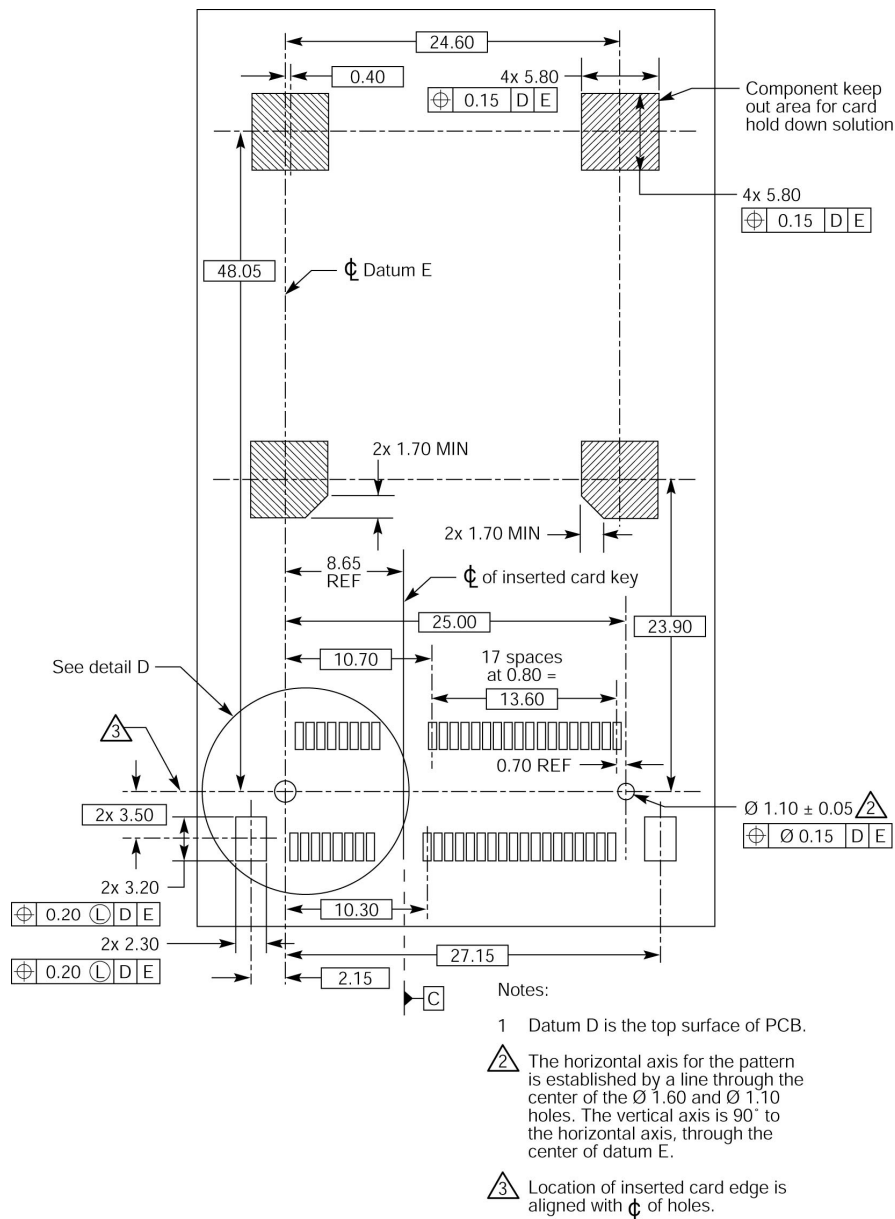


Figure 2-15: Recommended System Board Layout for Dual-Use Socket

2.5.3 Dual Head-to-Head Sockets

Figure 2-16 illustrates the concept of a dual head-to-head socket configuration. This optional configuration defines a two connector (A and B) solution that is intended to allow installation for

either one Full-Mini Card or two Half-Mini Cards. Figure 2-17 shows the recommended system board layout for this configuration based on overlaying the defined dual-use and Half-Mini-only sockets (see Figures 2-12 and 2-15 for additional dimensional details).

It is important to note the limitations regarding card compatibility with this socket configuration.

- 5 Connector A can accept all but the Type F1 Full-Mini Card. Connector B can only accept Type H2 Half-Mini Cards. When using two Half-Mini Cards in this configuration, care must be taken that at least one of those cards be Type H2.

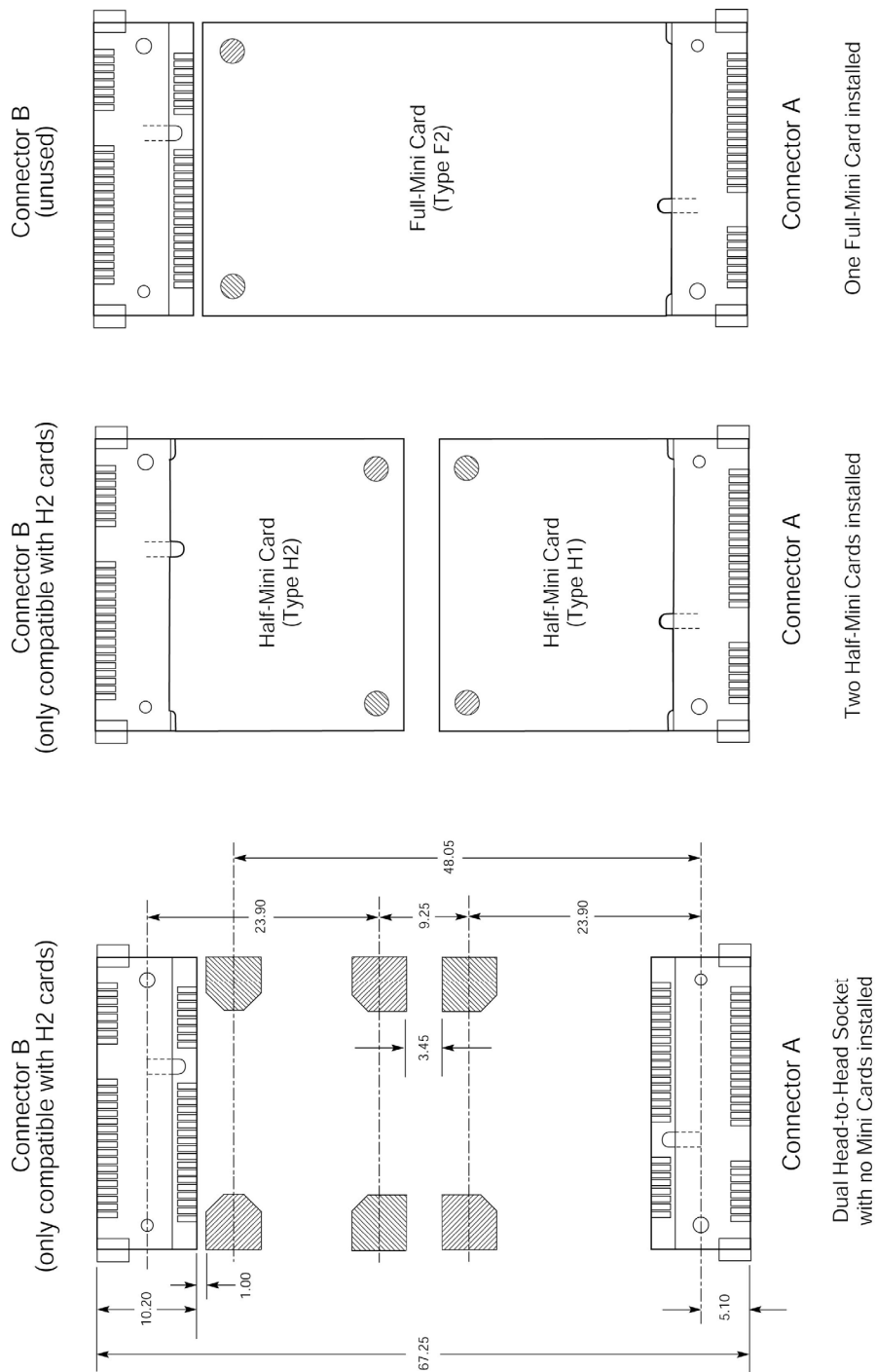


Figure 2-16: Dual Head-to-Head Socket

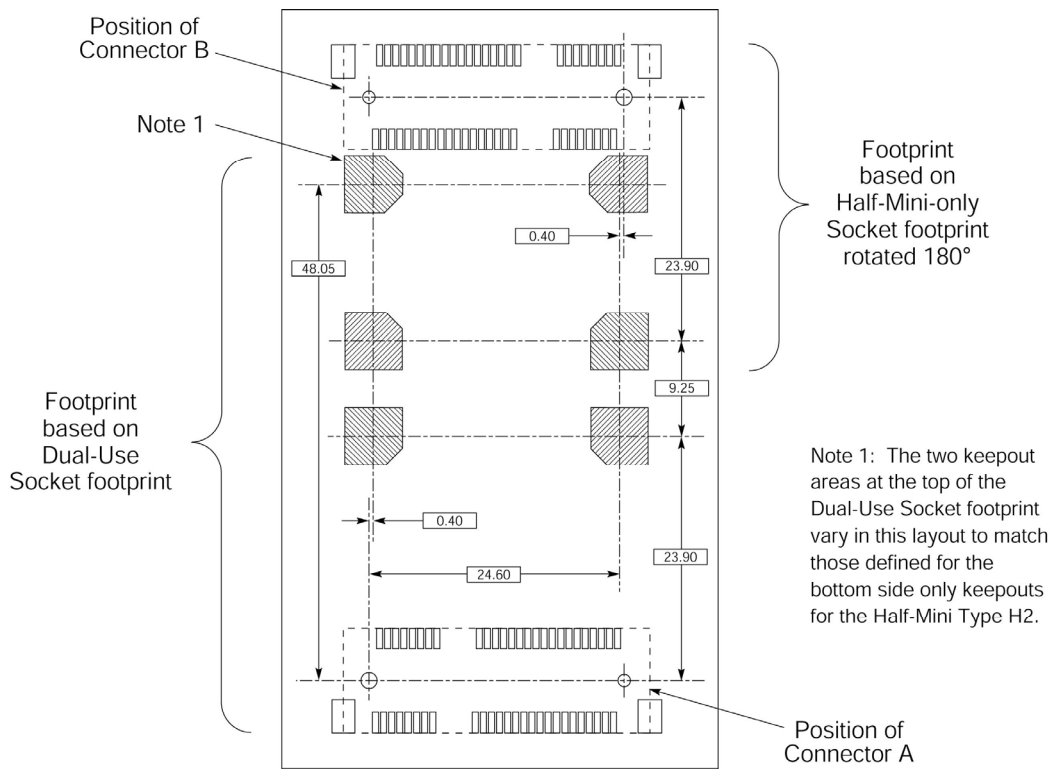
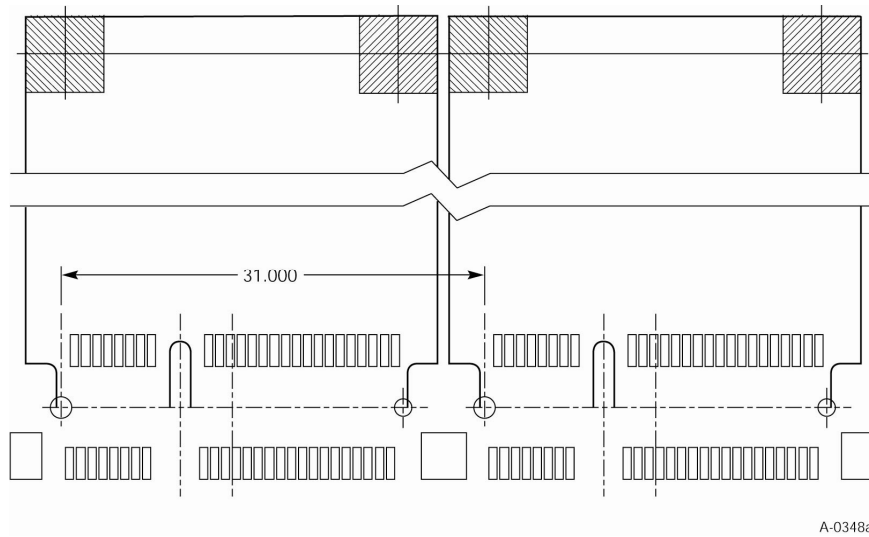


Figure 2-17: Recommended System Board Layout for Dual Head-to-Head Sockets

2.5.4 Side-by-Side Socket Spacing

Figure 2-18 shows the recommendation for placing Mini Card sockets side-by-side on a system board. This recommendation can be combined with any of the other system board recommendations for increased flexibility in managing multiple cards in a single platform.

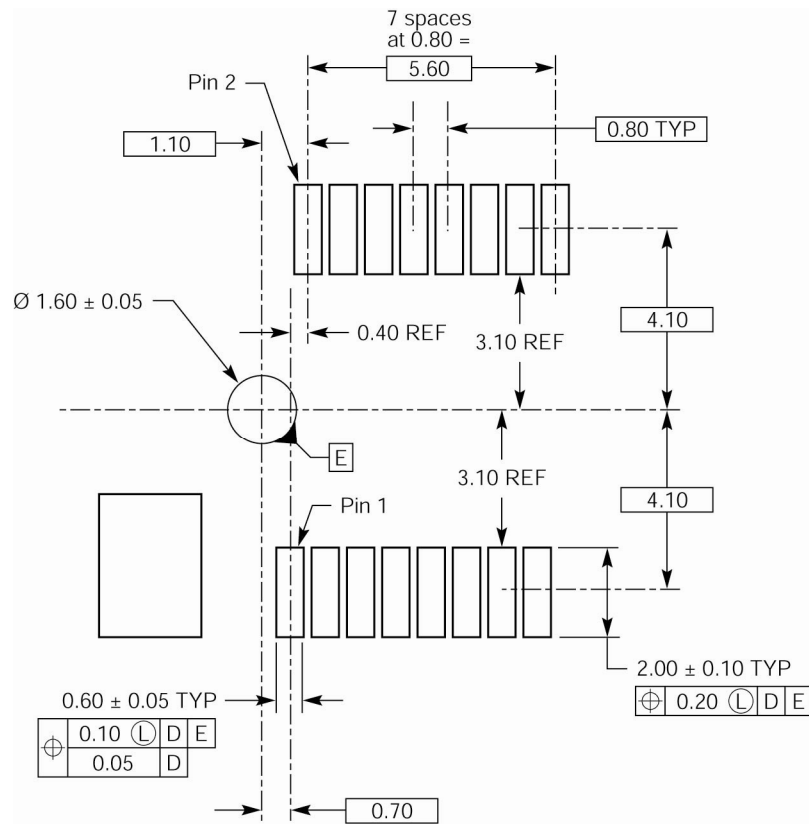


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Figure 2-18: Recommended System Board Layout (Side-by-Side Socket Spacing)

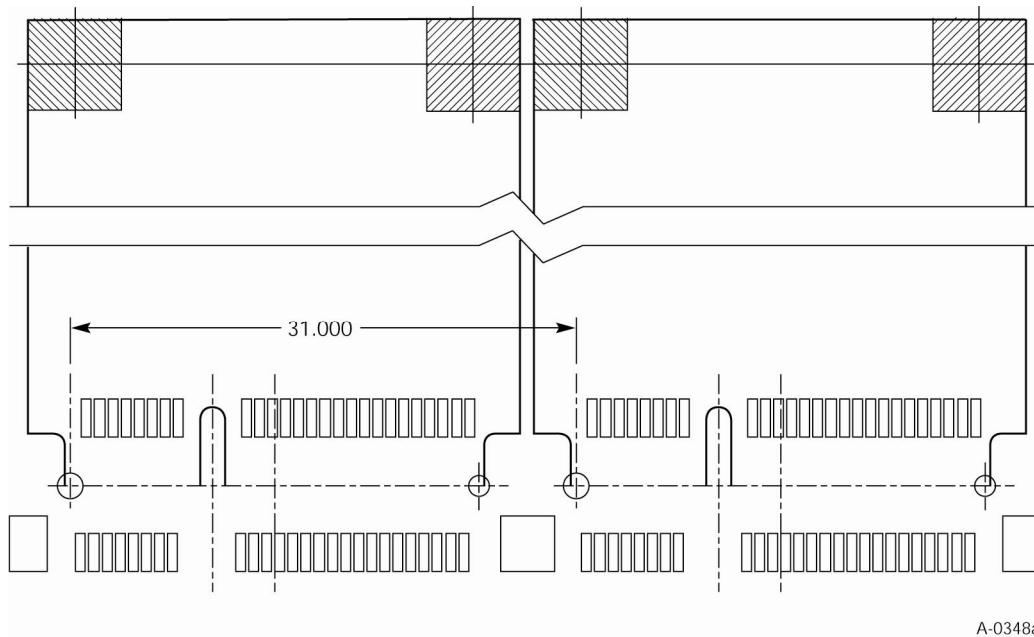
2.6 Thermal Guidelines





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Figure 2-11: Recommended System Board Layout (Detail D)



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Figure 2-12: Recommended System Board Layout (Dual Socket)